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John Baker

jbaker@21pstem.org

Robert Boruch

University of Pennsylvania, robertb@gse.upenn.edu

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Ambient Positional Instability Among Ohio Math and Science Teachers: 2008 to 2014

Abstract

This briefing is on teacher retention and Ambient Positional Instability (API) rates from 2008-09 to 2013-14 for math and science teachers in the state of Ohio. API is investigated in two ways; first, the cohort of math and science teachers teaching in the 2008-09 school year are followed over five years and, second, the population of math and science teachers are tracked from one year to the next over the same time period. Data analyses are presented with key findings identified. Instability rates tend to be stable year-to-year. Teachers in non-charter public schools in the five largest cities in Ohio have roughly 50% higher API than those teaching in non-charter high schools outside those cities. Charter schools have the highest level of API of any of the subpopulations of schools investigated. Implications for schools and research projects targeting secondary schools in Ohio are discussed.

Disciplines

Education | Other Education | Other Educational Administration and Supervision | Science and Mathematics Education | Urban Education

**AMBIENT POSITIONAL INSTABILITY AMONG OHIO MATH AND SCIENCE
TEACHERS: 2008 TO 2014**

John Baker and Robert Boruch

Working Paper/Briefing: API –Ohio-04/30/15

21st Century Partnership for STEM Education (21PSTEM)

Graduate School of Education
University of Pennsylvania

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Ambient Positional Instability among Ohio Math and Science Teachers: 2008-2014

John Baker and Robert Boruch

Working Paper/Briefing: API-Ohio

April 30, 2015

ABSTRACT

This briefing is on teacher retention and Ambient Positional Instability (API) rates from 2008-09 to 2013-14 for math and science teachers in the state of Ohio. API is investigated in two ways; first, the retention of all math and science teachers teaching in the 2008-09 school year are followed over five years and, second, year-to-year retention is tracked over the same time period. Data analyses are presented with key findings identified. Findings include: only one in two teachers, on average, will be teaching the same subject(s) at the same school after five years; teachers in non-charter public high schools in the five largest cities in Ohio have roughly 50% higher API than those teaching in non-charter high schools outside those cities; and charter schools have the highest level of API of any of the populations of high school teachers investigated. Implications for schools and research projects targeting high schools in Ohio are discussed.

John Baker, 21st Century Partnership for STEM Education/jbaker@21pstem.org

Robert Boruch, University of Pennsylvania/robertb@gse.upenn.edu

Ohio's Teacher Retention and Ambient Positional Instability Rates

John Y. Baker and Bob Boruch

April 30, 2015

Introduction

This briefing is on teacher retention and Ambient Positional Instability (API) rates from 2008-2009 to 2013-2014 for **math** and **science** teachers in the state of Ohio. The work is part of a project on API sponsored by the National Science Foundation and undertaken by 21PSTEM and the University of Pennsylvania. Ambient Positional Instability, as a metric, goes beyond typical measures of teacher attrition to include both those teachers who leave a school and those who remain but do not retain the same position. This second group is often ignored in policy discussions. We argue that it should not. Given our experience in educational research, in particular our experience conducting a randomized cluster trial targeting middle school science teachersⁱ, we have found that changes in teacher position can have a catastrophic impact on a multi-year study. Positional instability also has the potential to undermine school district initiatives where specific grades or subjects are targeted and then trained teachers are later shifted. There are many other possible effects of API, not all of which are negative. A manuscript further discussing these issues is in developmentⁱⁱ. For this brief, it suffices to say that API is worth investigating.

The following material outlines our analyses and provides information about the data resources and on their integration and editing. The statistical data in the charts here is foundational. A section summarizing salient findings in words is presented followed by a brief conclusion.

Data Resources, Integration, and Editing

The data was accessed at the following public website: <http://reportcard.education.ohio.gov/Pages/Power-User-Reports.aspx>. Six data files were downloaded containing all math and science teachers from the state of Ohio, one for each of the six school years from 2008-2009 to 2013-2014. The data files include five relevant fields: Unique Teacher ID (identification), District ID, School ID, School Type (elementary, middle, junior high, or high), and Course Subject Area (mathematics or science). The specificity of the publicly available Ohio data is restricted to whether a teacher teaches math or science and does not get at specific course assignment. More detailed data has been requested.

Each record in the data files represents a teacher ID associated with a single school and a single course subject area. Therefore, a teacher ID can exist more than once in a file for teachers with multiple assignments. For example, a teacher ID exists multiple times in a file if he or she teaches both mathematics and science in a given year. A teacher ID also exists multiple times if he or she teaches at multiple schools. In addition, some teachers in the files are not attached to any schools (e.g., math and science teachers attached to regional Education Service Centers that support local school districts).

In any big data project such as this, the accessible data must be edited so as to ensure understanding and coherence in its interpretation. The publicly accessible records from Ohio were edited as follows. All teachers who were not assigned to a school and all teachers who were assigned to more than one school were removed from the file. This left only teachers who taught at a single school in each of the data files. The data was then restructured so that multiple teacher records for any given ID (i.e., for those who taught both math and science) were merged into a single record. A new Subject Area field was created in the merged record with the following categories: science teacher, math teacher, and math and science teacher. The data files from the six school years were then merged and analyzed.

Analyses

Five different populations were investigated within the data. Descriptive statistics are presented for: (1) K-12 math and science teachers in the stateⁱⁱⁱ; (2) math and science teachers at non-charter public high school schools; (3) math and science teachers at charter/community^{iv} high schools; (4) math and science teachers at non-charter public high school schools in the five largest cities in Ohio; and (5) math and science teachers at non-charter public high schools outside of the five largest cities. The five largest cities are Columbus, Cleveland, Cincinnati, Toledo, and Akron.

Two types of analyses were conducted with each population: a **cohort** retention approach and a **year-to-year** retention approach. The cohort approach investigated the retention of the population of math and science teachers from the 2008-2009 school year through the 2013-2014 school year. The year-to-year approach investigated retention of all teachers from one year to the next. For instance, retention of all 2010-2011 math and science teachers into the 2011-2012 school year is reported.

Within each of these populations and analyses, retention was identified by different levels, from the least restrictive to the most. The *restrictiveness* of the level of retention relates to the specificity of a teaching position within the state. The most general classification of a teaching position is someone who teaches in the state. The position gets more specific as the district, then school, and finally subject(s) taught are associated with it. Along these lines, the least restrictive levels of retention include those teachers who are still a math or science teacher in the state (*In State*), those teachers who are still a math or science teacher in the same district (*In Same District*), and those teachers who are still a math or science teacher in the same school (*In Same School*). Rates for retention of math and science teachers in a school, independently, are also included. Our focus on those teachers who still teach the same combination of subjects—math, science, or math and science—in the same school (*In Same Subject(s) and School*) is the most restrictive category of descriptive data presented here. Much of the summary below is focused on this most restrictive category.

In the following section, the percentage of teachers who are retained is listed along with API rates. API is defined as the complement of retention. Mathematically, $API = 100\% - retention\%$. We emphasize API throughout, especially when looking at the most restrictive level of retention, as we believe API is a more accurate way to characterize the phenomenon at this level of specificity.

Summary of Selected Results

2008-2009 Cohort in Public Non-Charter Ohio High Schools

Let us focus first on the retention of a cohort of Ohio math and science teachers who changed in *both* school and the subjects in which they taught, ignoring any further change in the teacher's status (such as returning to the same position and subject). Chart 1a provides this information.

From Charts 1a, we learn that of the 2008-2009 cohort of teachers in all Ohio non-charter public high schools, about 81% remained in the same school teaching the same subject in 2009-2010 (i.e., the crude API is 19%). Five years later, in 2013-2014, only 47% were teaching in the same school and in the same subject area (i.e., the API is 53%).

These rates differ if one focuses only on the teachers in the five biggest cities. In particular, of the 2008-2009 cohort in these cities, 70% were teaching the same subject in the same school in 2009-2010. The API for cities then is 30%, which is well over the API rate of 19% over all teachers in the state and 17% for teachers outside the five big cities.

In the five biggest cities, the retention in the same school and subject five years later is far lower than the state as a whole. For instance, by 2013-2014, only 25% of the original cohort in the biggest cities remained in place. The API is 75% for cities, while the API for all non-public charter schools outside of these cities is 50%.

If one allows for the fact that some teachers may leave a school or subject area and then return to the same school and subject later, the rates follow roughly the same patterns. Taking replacements into account (Charts 1b), the API magnitudes differ only slightly from API when replacement is not taken into account (Charts 1a). For instance, the retention from the base year to the next in the five biggest cities is 70% and the API is then 30%, which is the same as without replacement. The API with replacement in cities by the fifth year is nearly the same as without replacement, i.e. 71% versus 75%.

Most important, the API in cities well exceeds API in the state as a whole or the API outside of cities by a factor of 1.5 or so. This regardless of whether one takes into account teachers changing and then returning to their original alignment to school and subject.

Year-to-Year Change

Chart 2 shows that from one year to the next, in all public non-charter Ohio high schools, about 78-81% of math and science teachers remained teaching in the same school and subject. For instance, in 2011-2012, 79% of the teachers also taught in 2010-2011. In 2013-2014, 78% of the teachers in the school were in the same position in 2012-2013. The year-to-year API is then 19-22%. The rates are very similar if we look at just the non-charter public high schools outside of the five biggest cities, ranging from 20-23%.

These results are in contrast to the year-to-year rates for the biggest cities. The retention ranges from a low of 63% for the group of teachers teaching in 2010-2011 to a high of 70% for those in 2009-2010. The year-to-year API is then 30-34%. Again, the API for cities is about 1.5 times the API for the state as a whole and API for the schools outside the five biggest cities.

Charter Schools

The proceeding discussion investigated only non-charter high schools. Charter schools are also worth investigation given their recent growth and their centrality to the national dialogue concerning public education. There are three trends to highlight with regard to the population of charter high school teachers in Ohio. First, charter high school teachers exhibit the highest API of any of the populations investigated in both cohort and year-to-year analyses. Second, the data reveal a substantial increase in the number of charter school teachers from 2008 to 2014. Third, the proportion of charter high school teacher who teach both mathematics and science is several times larger than the proportion of non-charter public high school teachers who teach both subjects.

Our main finding is that charter high school teachers were the most vulnerable population under investigation in reference to API. Regardless of type of analysis or level of retention, charter high school teachers in Ohio had the lowest retention rates and thus the highest API rates. Starting with the cohort analyses in Charts 1a, we see the retention rate of 15%, or an API of 85%, when looking at math and science teachers who kept their exact assignment over five years at charter high schools. These numbers contrast with the population of public non-charter high school teachers who have a retention rate of 47% in exact assignment, and with the population of public non-charter high school teachers from the five largest cities who have a retention rate of 25% in exact assignment. The accompanying API rates are 53% and 75%, respectively. In total, we see that charter high school teachers have an API rate that is 60% higher than their non-charter counterparts and 13% higher than their non-charter counterparts in the five largest cities.

The differences found in the cohort analyses are replicated in the year-to-year analyses, seen in Charts 2. The retention of teachers with the same assignment from one year to the next varies between a low of 55% to a high of 59% over the five year period of analysis for charter high school teachers. The retention rate in the state for public non-charter high schools is considerably higher, varying from a low of 78% to a high of 81%. As before, the teachers at public non-charter high schools in the five largest cities were between the other two populations, varying between a low of 63% and a high of 70%. On average over the five-year period, the API rates for charter high school teachers is 43%, for public non-charter high school teachers the API rate is 21%, and for the subpopulation of these teachers in the five largest cities the API rate is 34%.

The population of charter high school teachers in the 2008-09 school year was small; there were only 629 math and science teachers in the state of Ohio. The size and peculiarity of this group could have accounted for the findings in the cohort analysis. However, when looking at the year-to-year analyses, we see that the one-year retention and corresponding API rates remain somewhat constant in all populations. Therefore, looking across all of the analyses we can conclude that the charter schools had the highest incidence of API.

Secondary findings follow from the year-to-year analyses. First, we found that the number of high school charter school math and science teachers increased significantly over the five-year period of investigation. The population grew steadily from 629 in the 2008-2009 school year to 1468 in the 2013-

2014 school year, a net gain of 839 teachers. That is a 133% increase from the base year. That same time period saw a drop in the number of math and science teachers in non-charter public high schools, going from 11,353 to 10,652. That is a net loss of 701 teachers, a 6% decrease.

Second, we found a significantly higher proportion of teachers teaching both mathematics and science at charter high schools when compared to non-charter public high schools. Of the 11,353 math and science teachers at non-charter public high schools in the 2008-2009 school year, 1,156 taught both math and science, approximately 10%. Of the 629 math and science teachers at charter high schools in the 2008-2009 school year, 259 taught both math or science, approximately 41%. The average proportion of math and science high school teachers that teach both math and science from 2008 to 2014 is the same: 10% for non-charter public high schools and 41% for charter high schools. Charter high schools, therefore, have proportionally four times the number of teachers teaching across certification areas. This finding warrants further investigation.

Conclusion

Analyses have been presented from publicly available data from one state. The information presented is sobering. API for math and science teachers is high in Ohio:

- On average, only one in two teachers at non-charter public high schools retained the same position from the 2008-2009 school year to the 2013-2014 school year.
- API rates are 50% higher for city public high schools as compared to non-city schools.
- API rates are 60% higher for charter high schools compared to non-charter public high schools.

Furthermore, the publicly available data from Ohio was very coarse: teacher position was defined by general discipline (e.g., math and science). Consequently, all of the analyses underestimate the API. With higher quality data that ties teachers to specific grades and courses, the same analyses will produce higher API rates as teacher position, and changes, can be more accurately identified.

In sum, the public teacher data from Ohio provides a rough, albeit low, estimate of teacher instability in that state. Implications abound from these findings. High levels of API will impact research studies targeting teachers in schools as well as school interventions targeting particular grades and/or subject. This brief serves as a foundation by identifying base rates and showcasing the magnitude of positional instability rates in one state. Next steps include using more granular data to better estimate the phenomena, both in Ohio and in other jurisdictions, and to explore the various impacts of API on research studies and student achievement.

1a. 2008-09 Cohort 5-Year Retention Analyses (no replacement)^v

(1) All Schools						
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Math and Science Teachers: In State	57364 100%	50032 87%	44586 78%	39426 69%	34963 61%	30669 53%
Math and Science Teachers: In Same District	57364 100%	49474 86%	43866 76%	38699 67%	34187 60%	29795 52%
Math and Science Teachers: In Same School	57364 100%	47155 82%	40172 70%	33856 59%	28678 50%	24097 42%
Math and Science Teachers: In Same Subject(s) and School	57364 100%	44166 77%	36787 64%	30440 53%	25434 44%	21177 37%
Science Teachers: Same School	40868 100%	32907 81%	27789 68%	23372 57%	19669 48%	16443 40%
Math Teachers: Same School	46801 100%	37759 81%	31938 68%	26660 57%	22381 48%	18543 40%

(2) Public Non-Charter High Schools						
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Math and Science Teachers: In State	11353 100%	9954 88%	8917 79%	7969 70%	7154 63%	6403 56%
Math and Science Teachers: In Same District	11353 100%	9804 86%	8711 77%	7746 68%	6908 61%	6111 54%
Math and Science Teachers: In Same School	11353 100%	9579 84%	8256 73%	7218 64%	6385 56%	5586 49%
Math and Science Teachers: In Same Subject(s) and School	11353 100%	9238 81%	7910 70%	6917 61%	6110 54%	5337 47%
Science Teachers: Same School	6026 100%	4980 83%	4282 71%	3762 62%	3325 55%	2916 48%
Math Teachers: Same School	6483 100%	5270 81%	4448 69%	3857 59%	3376 52%	2907 45%

(3) Charter/Community High Schools						
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Math and Science Teachers: In State	629 100%	426 68%	337 54%	249 40%	199 32%	155 25%
Math and Science Teachers: In Same District	629 100%	376 60%	288 46%	209 33%	152 24%	111 18%
Math and Science Teachers: In Same School	629 100%	376 60%	288 46%	209 33%	154 24%	112 18%
Math and Science Teachers: In Same Subject(s) and School	629 100%	358 57%	271 43%	190 30%	132 21%	97 15%
Science Teachers: Same School	439 100%	256 58%	196 45%	134 31%	101 23%	73 17%
Math Teachers: Same School	449 100%	266 59%	206 46%	143 32%	103 23%	77 17%

(4) Public Non-Charter High Schools in 5 Largest Cities						
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Math and Science Teachers: In State	1465 100%	1209 83%	1043 71%	903 62%	753 51%	635 43%
Math and Science Teachers: In Same District	1465 100%	1205 82%	1027 70%	882 60%	728 50%	608 42%
Math and Science Teachers: In Same School	1465 100%	1102 75%	799 55%	657 45%	519 35%	417 28%
Math and Science Teachers: In Same Subject(s) and School	1465 100%	1026 70%	728 50%	597 41%	469 32%	373 25%
Science Teachers: Same School	847 100%	602 71%	423 50%	348 41%	270 32%	220 26%
Math Teachers: Same School	892 100%	658 74%	476 53%	393 44%	312 35%	244 27%

(5) Public Non-Charter High Schools outside of 5 Largest Cities						
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Math and Science Teachers: In State	9888 100%	8745 88%	7874 80%	7066 71%	6401 65%	5768 58%
Math and Science Teachers: In Same District	9888 100%	8599 87%	7684 78%	6864 69%	6180 63%	5503 56%
Math and Science Teachers: In Same School	9888 100%	8477 86%	7457 75%	6561 66%	5866 59%	5169 52%
Math and Science Teachers: In Same Subject(s) and School	9888 100%	8212 83%	7182 73%	6320 64%	5641 57%	4964 50%
Science Teachers: Same School	5179 100%	4378 85%	3859 75%	3414 66%	3055 59%	2696 52%
Math Teachers: Same School	5591 100%	4612 82%	3972 71%	3464 62%	3064 55%	2663 48%

1b. 2008-09 Cohort 5-Year Retention Analyses (with replacement)^{vi}

(1) All Schools						
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Math and Science Teachers: In State	57364 100%	50032 87%	45878 80%	41963 73%	38467 67%	34947 61%
Math and Science Teachers: In Same District	57364 100%	49474 86%	44994 78%	40898 71%	37201 65%	33415 58%
Math and Science Teachers: In Same School	57364 100%	47155 82%	41053 72%	35511 62%	30919 54%	26639 46%
Math and Science Teachers: In Same Subject(s) and School	57364 100%	44166 77%	37472 65%	31709 55%	27117 47%	23071 40%
Science Teachers: Same School	40868 100%	32907 81%	28238 69%	24230 59%	20835 51%	17762 43%
Math Teachers: Same School	46801 100%	37759 81%	32591 70%	27903 60%	24059 51%	20462 44%

(2) Public Non-Charter High Schools						
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Math and Science Teachers: In State	11353 100%	9954 88%	9174 81%	8452 74%	7843 69%	7290 64%
Math and Science Teachers: In Same District	11353 100%	9804 86%	8936 79%	8159 72%	7482 66%	6832 60%
Math and Science Teachers: In Same School	11353 100%	9579 84%	8451 74%	7568 67%	6854 60%	6148 54%
Math and Science Teachers: In Same Subject(s) and School	11353 100%	9238 81%	8082 71%	7213 64%	6502 57%	5815 51%
Science Teachers: Same School	6026 100%	4980 83%	4359 72%	3908 65%	3522 58%	3137 52%
Math Teachers: Same School	6483 100%	5270 81%	4572 71%	4067 63%	3647 56%	3248 50%

(3) Charter/Community High Schools						
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Math and Science Teachers: In State	629 100%	426 68%	365 58%	297 47%	265 42%	236 38%
Math and Science Teachers: In Same District	629 100%	376 60%	305 48%	228 36%	175 28%	133 21%
Math and Science Teachers: In Same School	629 100%	376 60%	305 48%	228 36%	175 28%	133 21%
Math and Science Teachers: In Same Subject(s) and School	629 100%	358 57%	283 45%	205 33%	150 24%	114 18%
Science Teachers: Same School	439 100%	256 58%	205 47%	147 33%	116 26%	89 20%
Math Teachers: Same School	449 100%	266 59%	213 47%	153 34%	113 25%	88 20%

(4) Public Non-Charter High Schools in 5 Largest Cities						
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Math and Science Teachers: In State	1465 100%	1209 83%	1090 74%	994 68%	856 58%	795 54%
Math and Science Teachers: In Same District	1465 100%	1205 82%	1073 73%	967 66%	824 56%	757 52%
Math and Science Teachers: In Same School	1465 100%	1102 75%	832 57%	712 49%	574 39%	487 33%
Math and Science Teachers: In Same Subject(s) and School	1465 100%	1026 70%	755 52%	635 43%	511 35%	424 29%
Science Teachers: Same School	847 100%	602 71%	442 52%	377 45%	297 35%	257 30%
Math Teachers: Same School	892 100%	658 74%	491 55%	425 48%	346 39%	279 31%

(5) Public Non-Charter High Schools outside of 5 Largest Cities						
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Math and Science Teachers: In State	9888 100%	8745 88%	8084 82%	7458 75%	6987 71%	6495 66%
Math and Science Teachers: In Same District	9888 100%	8599 87%	7863 80%	7192 73%	6658 67%	6075 61%
Math and Science Teachers: In Same School	9888 100%	8477 86%	7619 77%	6856 69%	6280 64%	5661 57%
Math and Science Teachers: In Same Subject(s) and School	9888 100%	8212 83%	7327 74%	6578 67%	5991 61%	5391 55%
Science Teachers: Same School	5179 100%	4378 85%	3917 76%	3531 68%	3225 62%	2880 56%
Math Teachers: Same School	5591 100%	4612 82%	4081 73%	3642 65%	3301 59%	2969 53%

2. Year-to Year Retention Analyses: 2008-09 to 2013-14^{vii}

(2) Public Non-Charter High Schools						
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Math and Science Teachers In State	11353	11306	11068	10677	10529	10652
Math and Science Teachers: In State from Previous Year		9954 88%	9880 87%	9557 86%	9187 86%	9042 86%
Math and Science Teachers: In Same District from Previous Year		9804 86%	9707 86%	9398 85%	9012 84%	8821 84%
Math and Science Teachers: In Same School from Previous Year		9579 84%	9335 83%	9117 82%	8818 83%	8582 82%
Math and Science Teachers: In Same Subject(s) & School from Previous Year		9238 81%	8988 79%	8799 79%	8488 79%	8239 78%
Science Teachers In State	6026	6030	5897	5714	5583	5566
Science Teacher Same School to Previous Year		4980 83%	4846 80%	4773 81%	4596 80%	4416 79%
Math Teachers In State	6483	6423	6254	6063	5998	6156
Math Teacher Same School to Previous Year		5270 81%	5106 79%	4989 80%	4873 80%	4754 79%

(3) Charter/Community High Schools						
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Math and Science Teachers In State	629	1066	1075	1228	1367	1468
Math and Science Teachers: In State from Previous Year		426 68%	753 71%	745 69%	887 72%	965 71%
Math and Science Teachers: In Same District from Previous Year		376 60%	687 64%	680 63%	788 64%	836 61%
Math and Science Teachers: In Same School from Previous Year		376 60%	687 64%	680 63%	788 64%	836 61%
Math and Science Teachers: In Same Subject(s) & School from Previous Year		358 57%	634 59%	625 58%	709 58%	752 55%
Science Teachers In State	439	755	738	820	945	978
Science Teacher Same School to Previous Year		256 58%	460 61%	446 60%	506 62%	533 56%
Math Teachers In State	449	796	790	906	994	1058
Math Teacher Same School to Previous Year		233 52%	504 63%	488 62%	569 63%	571 57%

(4) Public Non-Charter High Schools in 5 Largest Cities						
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Math and Science Teachers In State	1465	1446	1414	1349	1211	1258
Math and Science Teachers: In State from Previous Year		1209 83%	1215 84%	1177 83%	1052 78%	958 79%
Math and Science Teachers: In Same District from Previous Year		1205 82%	1195 83%	1168 83%	1039 77%	950 78%
Math and Science Teachers: In Same School from Previous Year		1102 75%	990 68%	1044 74%	952 71%	868 72%
Math and Science Teachers: In Same Subject(s) & School from Previous Year		1026 70%	910 63%	965 68%	871 65%	796 66%
Science Teachers In State	847	830	827	791	697	705
Science Teacher Same School to Previous Year		602 71%	530 64%	584 71%	516 65%	467 67%
Math Teachers In State	892	875	863	831	760	803
Math Teacher Same School to Previous Year		658 74%	584 67%	616 71%	582 70%	537 71%

(5) Public Non-Charter High Schools outside of 5 Largest Cities						
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Math and Science Teachers In State	9888	9860	9654	9328	9318	9394
Math and Science Teachers: In State from Previous Year		8745 88%	8665 88%	8380 87%	8135 87%	8084 87%
Math and Science Teachers: In Same District from Previous Year		8599 87%	8512 86%	8230 85%	7973 85%	7871 84%
Math and Science Teachers: In Same School from Previous Year		8477 86%	8345 85%	8073 84%	7866 84%	7714 83%
Math and Science Teachers: In Same Subject(s) & School from Previous Year		8212 83%	8078 82%	7834 81%	7617 82%	7443 80%
Science Teachers In State	5179	5200	5070	4923	4886	4861
Science Teacher Same School to Previous Year		4378 85%	4316 83%	4189 83%	4080 83%	3949 81%
Math Teachers In State	5591	5548	5391	5232	5238	5353
Math Teacher Same School to Previous Year		4612 82%	4522 82%	4373 81%	4291 82%	4217 81%

ⁱ 21st Century Center for Research and Development in Cognition and Science Instruction (IES award# R305C080009)

ⁱⁱ Boruch, Merlino, Baker, Bowden, Chao, Park, & Porter, *in review*

ⁱⁱⁱ Elementary teachers are identified as both math and science teachers.

^{iv} Ohio charter schools are referred to as both “charter” and community” schools. For simplicity, we will refer to both types of schools as charter schools.

^v “No replacement” means that once a teacher transfers schools or districts, he/she cannot re-enter the database at that school or district at a later date.

^{vi} “With replacement” means that a teacher can reenter the database if he/she returns to his/her original school/district after leaving.

^{vii} Year-to-year analysis includes all available teachers from one year and reports retention in the following year.